1 Safety In Extreme Environments

- Working in Remote or Outdoor Locations
- Temperature Extremes
 - Hot Environments
 - Cold Environments
- · Non-traditional Work Shifts
 - Night Work
 - Circadian Rhythms

Remote Locations

- Medical Services & First Aid (1926.50)
- First Aid Kits
- First Aid Training
- Emergency Procedures

3 Sanitation Requirements (1926.51)

- · Potable Water
- Food Handling
- Washing Facilities
- Eating and Drinking areas

4 Remote/Outdoor Locations

- Employer must provide appropriate PPE
- · Fire protection and prevention program at construction jobsites
- Safety training (1926.21)
- In job site areas where harmful plants or animals are present, employees who may
 be exposed shall be instructed regarding the potential hazards, and how to avoid
 injury, and the first aid procedures to be used in the event of an injury

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6 Heat Related Disorders

Prevention & Treatment

7 Where do we find hot work environments?

- Outdoors
 - Construction
 - Landscaping, Lawn Care
 - Mining
 - Agriculture
 - Amusement Parks, Resorts
 - Natural Resources, Oil, Gas, Forestry
 - Research Activities
 - Firefighters

8 Indoor Hot Work

- Foundries, Metallurgy, Steel Production
- Welding
- Brick Manufacturing
- Industries requiring significant clothing or PPE
 - Nuclear, Hazmat, Asbestos
- Firefighters
- Restaurants, Bakeries
- · Many other jobs without indoor cooling

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9 Heat Disorders

- Heat Related Definitions
 - Body Heat Storage Load
 - Metabolism
 - Radiant Heat Load
 - Convective Heat Load
 - Evaporative Heat Loss
- Heat Related Disorders
 - Prevention
 - Treatment
- Measurement of Heat Stress

10 H= M+-R+-C-E

- H = Body Heat Storage Load
- M = Metabolic Heat Gain
- R = Infrared Heat Load
- C = Convection Heat Load
- E = Evaporative Heat Loss

11 Heat Gain & Loss

- Hypothalmus of brain regulates the thermostat of the body (about 98.6 F)
- If too hot sweating increases, blood vessels dilate, blood sent away from core and to extremities
- This leads to water loss, some salt loss
- Effectiveness of sweating related to ability to sweat, skin surface area, clothing, temperature, humidity, air flow

12 Heat Exhaustion

- Caused by sustained exertion in heat, failure to drink enough water
- Symptoms include nausea, headache, cool & moist skin, low blood pressure, pale OR flushed skin, dizziness
- Treatment includes water replacement (drinking only if conscious), remove or loosen clothing, remove to cool area, apply wet cloths, rest, watch for changes in condition

13 Heat Stroke

- · Heat exhaustion can progress into heat stroke
- Life threatening condition with rapid rise of temperature and failure of the body's ability to cool itself
- Symptoms may include hot, dry, red skin, rapid, weak pulse, body temp over 104 F, rapid shallow breathing, loss of consciousness
- Must seek medical treatment, quickly cool the body

14 Heat Cramps

- Muscle pains or spasms associated with strenuous work and heavy sweating
- Treatment includes resting, stretching the muscles and drinking fluids w/electrolytes
- Consult physician about your salt intake

15 Other Heat Related Disorders

- Heat Syncope (Fainting)
 - Caused by standing immobile in heat, pooling of blood in lower parts of body

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- Prevent by moving around to allow blood to return to heart
- Skin Rash
 - Usually associated with humid heat or skin continuously wet with water
 - Prevent by drying skin, using good hygiene practices

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17 Factors Affecting Heat Stress

- State of Health
 - Genetics
 - Diseases, Medication
 - Age
- Conditioning & Acclimatization
- Acclimatized worker will have:
 - Lower heart rate, body temperature, higher sweat rate and more dilute sweat



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19 Heat Stress Factors (Cont.)

- Temperature
- Humidity
 - % humidity determines effectiveness of sweating
- Clothing
 - Unbreathable clothing can add to heat stress potential
- Airflow
 - Use of Fans
 - Air Conditioning or Swamp Coolers

20 Heat Stress Measurement

- Medical Indicators are the best predictors
 - Core temperature, blood pressure, heart rate
 - Often not practical to measure
- Environmental Measurements
 - Effective Temperature (ET) Index
 - Estimates the degree of warmth
 - Calculations take the humidity, air flow and temperature into account

21 Wet Bulb Globe Temperature (WBGT)

- Developed as a TLV by the American Conference of Governmental Industrial Hygienists (ACGIH)
- Based on work/rest cycles for different worker activity levels
- WBGT (outdoors) = .7tWB + .2tG + .1tDB
- tWB = wet bulb temperature
- tG = globe temperature
- tDB = dry bulb temperature

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22 Measuring Heat Stress (Example)

- · Two workers drilling boreholes in the desert
- 95 degrees F (35 C)
- · Very dry, low humidity, light breeze
- · WBGT measured values
 - -WB = 24, GT = 37, DB = 35

- WBGT = (.7)(24) + (.2)(37) + (.1)(35)
- $\bullet = 27.7$

23 Heat Stress Example

- For Moderate Work, Standard Work Uniform
- 75% to 100% Work at 28
- 50% to 75% Work at 29
- What made the biggest difference in this scenario?
 - Low humidity = very effective cooling
 - Airflow also helps the cooling process
- What would you expect for the same temperature with a humid day in Florida?

24 Preventing Heat Related Disorders

- Drink LOTS and LOTS of WATER
 - Don't wait till you feel thirsty
 - Plain cool water is better than other liquids
 - Avoid alcohol, caffeinated beverages (diuretics)
 - Gatorade, Powerade can help replace fluids and electrolytes and prevent or lessen cramps
 - Only use salt tablets if directed by a physician
 - Most of our diets contain significant salt

25 Prevention (cont.)

- Wear lightweight, light colored clothing
- Acclimatization, Conditioning
- Slow down when practical
 - Use rest breaks to rest
 - Significant heat load added by work activity
- Ventilation
 - Opening Windows
 - Fans

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27 Prevention (cont.)

- Eat smaller meals, avoid high protein foods
- Avoid direct sunlight when possible
- Do strenuous work during cooler parts of day
- Wear a hat when possible
- Use sunscreen
- Evaporative clothing
 - Bandanas, headbands, cooling vests

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28 Employee Training & Company Policy

- Causes, Signs, Symptoms, Treatment
- Water consumption & availability
- Breaks
- Sunscreen
- · Appropriate summer or hot work clothing
- · Reporting heat related incidents

29 Working in the Cold

- Normal Core Temperature about 99 degrees F
- Temperature regulated by hypothalamus

- Heat generated from food and activity
- · When cold the blood vessels are constricted to conserve heat and shivering to produce more heat

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31 Cold Disorders

- Hypothermia
- As core temperature drops the body tries to increase temperature. Symptoms may include
 - Uncontrollable shivering and cold sensation
 - Slow or irregular heartbeat, weak pulse, low blood pressure
 - Vague or slurred speech, incoherence
 - Fatigue, drowsiness

32 Hypothermia (continued)

- Extreme physical activity can increase the potential for hypothermia
 - Sweating
 - Exhaustion can interfere with constriction of blood vessels
 - Blood circulation after physical activity occurs closer to the skin resulting in more rapid heat loss
- Drugs and alcohol can increase risk of hypothermia

33 Frostbite

- · Freezing of the body cells
 - Common to nose, cheeks, ears fingers, toes
- Three degrees of frostbite
- Symptoms include skin changes usually to white then progressing to reddish/violet and then to purple or black as the tissues die
- · Cold & numbness initially and may change to blistering, pain, itching

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Cold Disorders Prevention & Treatment

- Adequate clothing for core and extremities
 - Avoid use of cotton in cold/wet environments
- · Adequate diet and water intake
 - Warm soups or drinks are good, avoid alcohol or caffeinated beverages
 - Ensure adequate water intake (clean, not too cold)
- · Reduce wind chill effect
- Spot heating to increase temperature

37 Prevention (continued)

- Use of hand held heaters, hand warmers
- Metal tools should be covered with insulating materials or use of gloves
- Warm up shelters or warm vehicles for breaks
- Adequate supervision or buddy system
- Employee training in causes, symptoms, prevention & treatment

38 Treatment

- Hypothermia treatment involves increasing the core temperature
 - Warm food &drinks, additional clothing, warm up areas with heaters
- Treatment for frostbite involves gradually warming the skin
 - Do not rub frostbitten skin
- Medical attention for those displaying symptoms of hypothermia or frostbite

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39 Unusual Work Schedules

- About 25% of the workforce works some type of shiftwork
- These non-typical work schedules may contribute to increased risk of injury
- Shiftwork has also been associated with increased risk of health problems
 - Increased digestive problems
 - May aggravate existing conditions

40 Circadian Rhythm

- Circadian Rhythm is used to describe our biological daily clock
- Typical clock for most people is based on <u>about</u> 24 hours (one earth rotation)
- Related to the light dark cycle
- Our clock typically "resets" itself once a day
- Shift work can interrupt this clock
 - Jet lag, fatigue, insomnia, irritability

41 Biological Clock (Continued)

- Indicators of our biological clock include body temperature, heart rate, blood pressure, hormone levels, metabolism, and alertness
- Typical peak hours are 8 to 10 AM and 3 to 6 PM
- Deep sleep, low temperature, and low metabolism usually occurs from about 2 to 5 AM.
- Another low occurs from about 1 PM to 2:30 PM (after lunch nap)

42 Shift Work and Accidents

- Night work and illumination
 - Not seeing the hazard (excavations, projections, fall hazards, uneven walking surfaces, holes, clutter, cords, other workers)
- Fatique
 - Slowed response times
 - Falling asleep while driving (trucking)
- · Lack of supervision, taking chances, not following company policy
- Increased use and/or abuse of drugs/alcohol
- Human error rate increased due to all the above

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43 Long Work Shifts (including day and night work)

- Fatigue factors
- Less recovery or rest time
- · Ergonomic concerns
- OSHA Permissible Exposure Limits (PEL) for chemical contaminants generally based on 8 hour workday
 - May not be protective enough
- Noise permissible exposure limit based on duration of exposure

44 Preventing Accidents

- Reducing Fatigue
 - No substitute for adequate sleep
 - Sleep quality and quantity are important
 - Sleep debt
 - Stimulants, coffee
- · Employee Training
 - Importance of sleep, circadian rhythm, managing home life, lifestyle factors
 - Ask for their input

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45 Designing Work Schedules

- Disagreement on the "perfect" length of the rotation period
- · Forward rotating shifts generally work better
 - (day shift to swing shift, swing shift to night shift)
- Avoid early day shift start times (4 or 5 AM)
- The largest rest break should occur after the night shift rotation (at least 24 hours)
- · Avoid double shifts
- Keep affected employees informed

46 Preventing Night Time Accidents

- Provide Adequate Illumination
 - OSHA Construction Standard (1926.56)
 - 5 foot candles for general area lighting
 - 30 foot candles for first aid stations and offices
- Use of reflective clothing for night work
- Driving safety training for all drivers
 - Driving fatigue
 - Company driving policy including seat belt policy

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47 Stress and Accidents

48 Managing Stress

- Stress can be a major contributing factor of accidents
- Happy Employees
 - Lower turnover
 - Fewer accidents and injuries, quicker recovery
 - Increased productivity

49 Stress Reduction for Shift Workers

- · Getting adequate sleep
- Diet (on and off the job)
- Exercise
- Managing home life (off the job time)
 - Educating Family & Friends
 - Allowing flex time
 - Use of Vacation & Sick Leave

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